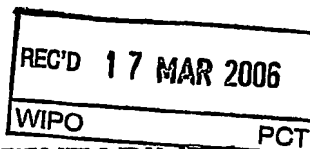


PATENT COOPERATION TREATY

PCT



INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

CORRECTED
VERSION

| | | |
|---|---|---|
| Applicant's or agent's file reference ASW1758 | FOR FURTHER ACTION See Form PCT/PEA/416 | |
| International application No. PCT/GB2004/004698 | International filing date (day/month/year) 08.11.2004 | Priority date (day/month/year) 20.11.2003 |
| International Patent Classification (IPC) or national classification and IPC INV. G01F17/00 G01F23/14 G01F22/02 | | |
| Applicant INTELLIENT et al. | | |
| <p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 7 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p style="margin-left: 20px;">a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 2 sheets, as follows:</p> <p style="margin-left: 40px;"><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p style="margin-left: 40px;"><input checked="" type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in Item 4 of Box No. I and the Supplemental Box.</p> <p style="margin-left: 20px;">b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p> | | |
| <p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the report</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p> | | |
| Date of submission of the demand 17.06.2005 | Date of completion of this report 16.03.2006 | |
| Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016 | Authorized officer Barthélemy, M Telephone No. +31 70 340-4376 | |



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2004/004698

Box No. 1 Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-9 as originally filed

Claims, Numbers

1-9 received on 27.02.2006 with letter of 27.02.2006

Drawings, Sheets

1/3-3/3 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☒ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☒ the claims, Nos. 10-12
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing *(specify)*:
 - ☐ any table(s) related to sequence listing *(specify)*:
4. ☒ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☒ the claims, Nos. 7-9
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing *(specify)*:
 - ☐ any table(s) related to sequence listing *(specify)*:

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2004/004698

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|-------------------------------|-------------|-----|
| Novelty (N) | Yes: Claims | 1-9 |
| | No: Claims | |
| Inventive step (IS) | Yes: Claims | 1-9 |
| | No: Claims | |
| Industrial applicability (IA) | Yes: Claims | 1-9 |
| | No: Claims | |

2. Citations and explanations (Rule 70.7):

see separate sheet

**INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY
(SEPARATE SHEET)**

International application No.

PCT/GB2004/004698

Re Item I

- 1 The subject-matter "a *continuous* change in the volume of the gas" of the claims 7, 8 and 9 go beyond the disclosure of the application as filed (Article 34(2)(b) PCT). The present report will be issued on said claims as if the word "continuous" would have been deleted.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

- 2 Reference is made to the following documents:

D1: DE 195 19 723 A1 (NICOLAI WALTER) 21 March 1996 (1996-03-21)
D2: DE 37 19 551 A1 (IGENWERT GMBH) 29 December 1988 (1988-12-29)
D3: US 5 001 924 A (WALTER ET AL) 26 March 1991 (1991-03-26)
D4: US 4 770 033 A (NICOLAI) 13 September 1988 (1988-09-13)
D5: US 4 713 966 A (THYREN ET AL) 22 December 1987 (1987-12-22)

3 Claims 1-7

- 3.1 The document D3 is regarded as being the closest prior art to the subject-matter of claim 1, and shows (the references in parentheses applying to this document) a volume measuring device for measuring a volume of gas within a vessel (abstract; figure 1), said device being arranged to produce a change in the volume of the gas (abstract) and to measure the change of pressure of the gas (abstract) with respect to said volume change, and determine the volume of the gas from said volume change and corresponding pressure change (abstract; column 3, lines 1-8). Document D3 also discloses the alternative measurement of the work provided for said volume change and the determination of said gas volume from said measured volume change and work (abstract; column 8, lines 3-7).

Document D3 discloses several measurements (column 4, line 33-column 6, line 55), these measurements being made for different rates of volume changes (dV/dt) (column 5, lines 1-5 and 15-21) and a general equation (14) being deducted which is numerically solved to obtain a constant ΔP_{iso} . From this constant and equation (5), one can calculate the volume of gas from said constant and the separately measured static pressure. The device in D3 is additionally arranged to measure the static pressure in the tank (D3, column 3, lines 15-23 and column 6, lines 52-55). The device is therefore provided with an additional total pressure sensor (D3, column 3, lines 38-40; figure 1).

- 3.2 The subject-matter of claim 1 differs from this known device in that it is arranged to determine several incremental changes of volume throughout the change in volume and measure incremental pressure changes associated with respective volume changes, and in that it is arranged to determine the volume of gas from said volume changes and associated rate of pressure changes with respect to said volume changes by determining from said measurements a straight line relationship. The subject-matter of claim 1 is therefore new (Article 33(2) PCT).
- 3.3 The problem to be solved by the present invention may be regarded as to find an alternative to said device disclosed in D3 in which there is no need to measure the static pressure in the tank.
- 3.4 The solution proposed by the present invention provides several volume changes and corresponding pressure changes measurements within a piston stroke and links them directly in a linear mathematical relationship from which the gas volume can be easily deducted. The solutions of D3 and the present invention have therefore completely different mathematical approaches to the problem of measuring the gas volume within a vessel. The method proposed by said invention has no need to measure independently the static pressure within the tank. The solution to this problem proposed in claim 1 of the present application is therefore considered as involving an inventive step (Article 33(3) PCT).
- 3.5 Claims 2-6 and claim 7 (when considered without the word "continuous", see paragraph 1 above) are dependent on claim 1 and as such also meet the

requirements of the PCT with respect to novelty and inventive step.

4 Claims 8 and 9

- 4.1 Claims 8 and 9 are considered here without the word "continuous" (see paragraph 1 above).
- 4.2 Claim 8 lacks clarity because an **essential feature** (use the measurements to determine a straight relationship) is **missing** (Article 6 PCT taken in combination with Rule 6.3(b) PCT).
- 4.3 The document D3 is regarded as being the closest prior art to the subject-matter of claim 8, and discloses a method of measuring a volume of gas within a vessel as described in paragraph 3.1 above.
- 4.4 The subject-matter of claim 8 differs from this known method in that additional steps are provided: determining incremental changes of volume throughout the change in volume and measuring incremental pressure changes associated with respective volume changes, and determining the volume of gas from said volume changes and associated rate of pressure changes with respect to said volume changes. The subject-matter of claim 8 is therefore new (Article 33(2) PCT).
- 4.5 The problem to be solved by the present invention may be regarded as to find an alternative to said device disclosed in D3 in which there is no need to measure the static pressure in the tank.
- 4.6 The solution to this problem proposed in claim 8 of the present application is considered as involving an inventive step (Article 33(3) PCT), see paragraph 3.4.
- 4.7 Claims 9 is dependent on claim 8 and as such also meets the requirements of the PCT with respect to novelty and inventive step.

5 Further matter

5.1 The application does not meet the requirements of **Article 6 PCT**, because claims 5 and 6 are not clear.

5.1a It is not clear from claim 5 of what the first and second derivative are.

5.1b It is not clear from claim 6 what the straight line does intercept.

5.2a Document D1 discloses a device and a method for implementing a volume change in order to be able to measure the gas volume within a vessel. Only one volume change (initial/final) is foreseen (column 1, lines 29-51; claim 1).

5.2b Document D2 discloses a device and a method for measuring the volume of a gas within a vessel in which the work done for changing the gas volume between two (initial/final) volumes is measured as well as the two corresponding pressures. From said measurements, an equation gives said volume (claim 1).

5.2c Document D4 discloses a device and a method for measuring the volume of a gas within a vessel in which only one volume change (initial/final) is used (column 2, lines 43-44; column 3, lines 17-23).

5.2d Document D5 discloses a device and a method for measuring the volume of a gas within a vessel in which the volume change is cyclic and its amplitude changes until a predetermined pressure change is reached, said pressure change being the only measurement used for calculating the gas volume (abstract; claim 1). Two measurements may be done for different neutral positions of the piston (column 4, lines 8-10).

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CLAIMS

1. A volume measuring device for measuring a volume of gas within a vessel, the device being arranged to:
 - produce a change in the volume of the gas;
 - measure the rate of change of pressure of the gas with respect to volume by determining incremental changes of volume throughout the change in volume, and measuring incremental pressure changes associated with respective volume changes, or work done during respective volume changes;
 - use the measurements to determine a straight line relationship; and
 - determine the volume of the gas from the volume changes and either the pressure changes or the work done.
2. A device according to claim 1 including a piston arranged to produce the change in volume of gas in a single stroke.
3. A device according to claim 1 or claim 2 including a pressure sensor arranged to measure the incremental pressure changes.
4. A device according to claim 3 arranged to estimate a best fit straight line relationship from the measurements.
5. A device according to claim 3 or claim 4 wherein the straight line relationship includes first and second derivatives.
6. A device according to any of claims 3 to 5 arranged to determine the volume from an intercept of the straight line relationship.
7. A device according to any foregoing claim including a piston arranged to produce the continuous change in volume.
8. A method of measuring a volume of gas within a vessel, the method comprising:

producing a continuous change in the volume of the gas;
measuring the rate of change of pressure of the gas with respect to volume
by
determining incremental changes of volume throughout the continuous
change in volume and
measuring incremental pressure changes associated with respective volume
changes, or work done during respective volume changes, and
determining the volume of the gas from the volume changes and either the
pressure changes or the work done.

9. A method according to claim 8 wherein the gas is part of a di-phasic
mixture.